

**$\Delta(1900)$   $S_{31}$**  $I(J^P) = \frac{3}{2}(\frac{1}{2}^-)$  Status:  $\ast\ast$ 

## OMITTED FROM SUMMARY TABLE

Some obsolete results published before 1980 were last included in our 2006 edition, Journal of Physics, G **33** 1 (2006).

The latest GWU analysis (ARNDT 06) finds no evidence for this resonance.

 **$\Delta(1900)$  BREIT-WIGNER MASS**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>1850 to 1950 (<math>\approx 1900</math>) OUR ESTIMATE</b>			
1920 $\pm 24$	MANLEY 92	IPWA	$\pi N \rightarrow \pi N & N\pi\pi$
1890 $\pm 50$	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
1908 $\pm 30$	HOEHLER 79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1802 $\pm 87$	VRANA 00	DPWA	Multichannel
1918.5 $\pm 23.0$	CHEW 80	BPWA	$\pi^+ p \rightarrow \pi^+ p$
1803	CRAWFORD 80	DPWA	$\gamma N \rightarrow \pi N$

 **$\Delta(1900)$  BREIT-WIGNER WIDTH**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>140 to 240 (<math>\approx 200</math>) OUR ESTIMATE</b>			
263 $\pm 39$	MANLEY 92	IPWA	$\pi N \rightarrow \pi N & N\pi\pi$
170 $\pm 50$	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
140 $\pm 40$	HOEHLER 79	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
48 $\pm 45$	VRANA 00	DPWA	Multichannel
93.5 $\pm 54.0$	CHEW 80	BPWA	$\pi^+ p \rightarrow \pi^+ p$
137	CRAWFORD 80	DPWA	$\gamma N \rightarrow \pi N$

 **$\Delta(1900)$  POLE POSITION****REAL PART**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1780	<sup>1</sup> HOEHLER 93	SPED	$\pi N \rightarrow \pi N$
1870 $\pm 40$	CUTKOSKY 80	IPWA	$\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1795	VRANA 00	DPWA	Multichannel
not seen	ARNDT 91	DPWA	$\pi N \rightarrow \pi N$ Soln SM90
2029 or 2025	<sup>2</sup> LONGACRE 78	IPWA	$\pi N \rightarrow N\pi\pi$

## **-2×IMAGINARY PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
180±50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
<b>• • • We do not use the following data for averages, fits, limits, etc. • • •</b>			
58	VRANA	00	DPWA Multichannel
not seen	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90
164 or 163	<sup>2</sup> LONGACRE	78	IPWA $\pi N \rightarrow N\pi\pi$

## **Δ(1900) ELASTIC POLE RESIDUE**

### **MODULUS |r|**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
10±3	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

### **PHASE θ**

<u>VALUE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
+20±40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

## **Δ(1900) DECAY MODES**

The following branching fractions are our estimates, not fits or averages.

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $N\pi$	10–30 %
$\Gamma_2$ $\Sigma K$	
$\Gamma_3$ $N\pi\pi$	
$\Gamma_4$ $\Delta\pi$	
$\Gamma_5$ $\Delta(1232)\pi$ , D-wave	
$\Gamma_6$ $N\rho$	
$\Gamma_7$ $N\rho$ , S=1/2, S-wave	
$\Gamma_8$ $N\rho$ , S=3/2, D-wave	
$\Gamma_9$ $N(1440)\pi$ , S-wave	
$\Gamma_{10}$ $N\gamma$ , helicity=1/2	

## **Δ(1900) BRANCHING RATIOS**

### **$\Gamma(N\pi)/\Gamma_{\text{total}}$**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.1 to 0.3 OUR ESTIMATE</b>			
0.41±0.04	MANLEY	92	IPWA $\pi N \rightarrow \pi N$ & $N\pi\pi$
0.10±0.03	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
0.08±0.04	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
<b>• • • We do not use the following data for averages, fits, limits, etc. • • •</b>			
0.33±0.10	VRANA	00	DPWA Multichannel
0.28	CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow \Sigma K$	$(\Gamma_1 \Gamma_2)^{1/2} / \Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
<0.03	CANDLIN 84 DPWA $\pi^+ p \rightarrow \Sigma^+ K^+$
$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow \Delta(1232)\pi, D\text{-wave}$	$(\Gamma_1 \Gamma_5)^{1/2} / \Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
+0.25±0.07	MANLEY 92 IPWA $\pi N \rightarrow \pi N \& N\pi\pi$
$\Gamma(\Delta(1232)\pi, D\text{-wave}) / \Gamma_{\text{total}}$	$\Gamma_5 / \Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
0.28±0.01	VRANA 00 DPWA Multichannel
$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow N\rho, S=1/2, S\text{-wave}$	$(\Gamma_1 \Gamma_7)^{1/2} / \Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
-0.14±0.11	MANLEY 92 IPWA $\pi N \rightarrow \pi N \& N\pi\pi$
$\Gamma(N\rho, S=1/2, S\text{-wave}) / \Gamma_{\text{total}}$	$\Gamma_7 / \Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
0.30±0.02	VRANA 00 DPWA Multichannel
$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow N\rho, S=3/2, D\text{-wave}$	$(\Gamma_1 \Gamma_8)^{1/2} / \Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
-0.37±0.07	MANLEY 92 IPWA $\pi N \rightarrow \pi N \& N\pi\pi$
$\Gamma(N\rho, S=3/2, D\text{-wave}) / \Gamma_{\text{total}}$	$\Gamma_8 / \Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
0.05±0.01	VRANA 00 DPWA Multichannel
$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow N(1440)\pi, S\text{-wave}$	$(\Gamma_1 \Gamma_9)^{1/2} / \Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
-0.16±0.11	MANLEY 92 IPWA $\pi N \rightarrow \pi N \& N\pi\pi$
$\Gamma(N(1440)\pi, S\text{-wave}) / \Gamma_{\text{total}}$	$\Gamma_9 / \Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>
0.04±0.01	VRANA 00 DPWA Multichannel

### $\Delta(1900)$ PHOTON DECAY AMPLITUDES

#### $\Delta(1900) \rightarrow N\gamma, \text{ helicity-1/2 amplitude } A_{1/2}$

<u>VALUE</u> ( $\text{GeV}^{-1/2}$ )	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-0.004±0.016	CRAWFORD 83	IPWA	$\gamma N \rightarrow \pi N$
0.029±0.008	AWAJI 81	DPWA	$\gamma N \rightarrow \pi N$
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$			
-0.006 to -0.025	CRAWFORD 80	DPWA	$\gamma N \rightarrow \pi N$

## **Δ(1900) FOOTNOTES**

- <sup>1</sup> See HOEHLER 93 for a detailed discussion of the evidence for and the pole parameters of  $N$  and  $\Delta$  resonances as determined from Argand diagrams of  $\pi N$  elastic partial-wave amplitudes and from plots of the speeds with which the amplitudes traverse the diagrams.  
<sup>2</sup> LONGACRE 78 values are from a search for poles in the unitarized T-matrix. The first (second) value uses, in addition to  $\pi N \rightarrow N\pi\pi$  data, elastic amplitudes from a Saclay (CERN) partial-wave analysis.

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## **Δ(1900) REFERENCES**

For early references, see Physics Letters **111B** 1 (1982).

ARNDT	06	PR C74 045205	R.A. Arndt <i>et al.</i>	(GWU)
PDG	06	JPG 33 1	W.-M. Yao <i>et al.</i>	(PDG Collab.)
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman,, T.-S.H. Lee	(PITT+)
HOEHLER	93	$\pi N$ Newsletter 9 1	G. Hohler	(KARL)
MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski	(KENT) IJP
Also		PR D30 904	D.M. Manley <i>et al.</i>	(VPI)
ARNDT	91	PR D43 2131	R.A. Arndt <i>et al.</i>	(VPI, TELE) IJP
CANDLIN	84	NP B238 477	D.J. Candlin <i>et al.</i>	(EDIN, RAL, LOWC)
CRAWFORD	83	NP B211 1	R.L. Crawford, W.T. Morton	(GLAS)
AWAJI	81	Bonn Conf. 352	N. Awaji, R. Kajikawa	(NAGO)
Also		NP B197 365	K. Fujii <i>et al.</i>	(NAGO)
CHEW	80	Toronto Conf. 123	D.M. Chew	(LBL) IJP
CRAWFORD	80	Toronto Conf. 107	R.L. Crawford	(GLAS)
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
Also		PR D20 2839	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP
LONGACRE	78	PR D17 1795	R.S. Longacre <i>et al.</i>	(LBL, SLAC)

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